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The Influence of Money Supply and Interest Rate on Inflation

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The following article analysis the influence of the money supply and interest rate over inflation. In order to prove our assumptions we have followed the date available in the United States and China over a period of 24 years (1987-2011). These two countries are so different and yet similar in many ways. Although China does not support USA and tries to outweigh USA as the most important economy in the world, it is an important pioneer of promoting the US dollar, by keeping its exchange rate pegged to the USD. This research will prove that these economies depend on each other. The article presents a different statistical approach in analyzing the effects of money supply and interest on inflation but not the other way around. Different monetary policies embraced by China and USA can be the starting point in estimating inflation by using past data and analyzing monetary policies adopted along the years. The model created will present different applicability on China and USA. This is because of the influence of the political sector over the Chinese economy and the unhealthy growth of the money supply. By using monthly data for several years in Mathlab, an approximate equation with low level of error it is desired. As long as the data are accurate, this research could create a clear and healthy image of the monetary system of an economy. The main question after this research was the high error of the equation resulted in China, although using the same statistical database. Are the data published for monetary indicators in China are accurate?

Keywords: inflation, money supply, interest rate, monetary policy instruments, economic growth

Introduction

Every national economy tries to become more competitive on the global market by controlling some macroeconomic indicators. This manipulation can offer a significant competitive advantage. One of the most important macroeconomic indicators that truly influence economy is the inflation; controlled properly and related to other indicators, the inflation can be the starting point for an economic growth and healthy development. Considering this assumption, this research will analyze the link between the inflation rate in a specific period of time (1987-2011), money supply and interest rate for USA and China. By using the econometric theory of multiple regressions in Matlab this statistical approach could give a starting point in estimating inflation over time in terms of monetary mass and interest rate. A lot of empirical studies a long time proved the effects of increasing money supply can have over interest rate and also inflationary effects. The

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main conclusion is that an unanticipated increase in money supply will lead to an increase in interest rate (in order to anticipate the tightening in monetary pace). This would lead to sustained price raises, meaning inflation. This research brings a new approach and tries to set new models for anticipating inflation by analyzing trends in money supply and interest rate over the years.

Globalization and Monetary Policy

The globalization may be the most important trend exhibited in a modern economy. There were a lot of discussion about its effects on every country's economic branches, on the macroeconomic policy, on economic growth and durable national development. Those discussions actually built the global economy. It is well known that every national economy must bear in mind the following objectives: increasing the employment in the work force, the level of economic growth, and price stability. The globalization lets its fingerprint on these instruments, too.

Its effects in this way are different from the dependence on imports or economic structure of the considered country. The monetary policy can be defined as a strategy of the monetary authorities to control the paper money supply and inflation. One of the main instruments of the monetary policy is the inflation rate; it can be shown in a range of mechanisms that influence the economic stability and growth. It is maybe the most important way whereby globalization has a strong effect on the monetary policy if we consider the China's case with the free circulation of cheap and products with questionable quality.

Transmission of Monetary Policy

In order to analyze the transmission mechanism of a monetary policy, Figure 1 provides an overall view. As can be seen, when inflation exceeds a certain level, the central bank will probably interfere with a contraction strategy by increasing the basic rate. In a free market, any modification of the basic rate will appear like a refinancing cost, getting to a rising of those rates on other markets, as the deposit rate or mortgage rates. It is obvious that any modification of a fiscal policy will affect economy's future, and influences the market trust, asset price, and exchange rates. The consumers and the investors have the tendency to adjust the consumption and investments correspondent to these modifications; this leads to changes in aggregate demand and supply. When the money supply increases, the inflation rate decreases. If the inflation rate increases the money paper demand drops to get in balance (Blanchard, 2003).

Regarding the instruments of the monetary theory, inflation can be defined as the increase in money supply on a long term. Studies concerning inflation in China showed a strong link between this supply and inflation rate. Thus, increasing spending and decreasing credits' demands will lead to a decrease of the real sector and inflationist pressure. Wu Xiaoling who is the vice-president of Finance and International Business Committee said that "In recent 30 years, we used excessive the paper money supply to advance the economy". The official reason for this supply's accession of China is attached to the exchange behavior. According to this behavior, for every appreciation with one dollar in its foreign currency fund, the Central Bank of China emits the same quantity of Yuan in their economy.

This problem is not new, but June 2011 brought a real possibility of passing up the inflation target (5.5%). In July, only the prices increased with 6.5%. This accession is very risky for an economy similar to China's dependent on exports because a big inflation rate would bring the impossibility for the government to adopt an expansionary monetary policy in the case of international turbulences. When the crisis began, it was shown that

when the economy diminished, authorities acted rapidly by increasing the money supply (operations on the money market and authorizations for lending's). And the constant increase in money supply could be threatening.

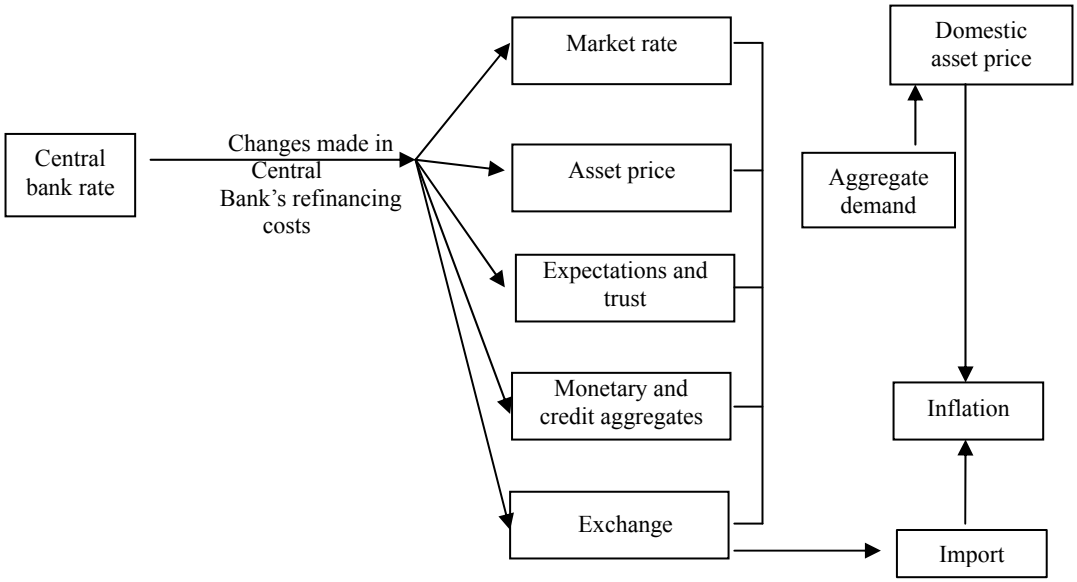

Figure 1. The transmission mechanism of the monetary policy (conventional form). Source: Yao, Lou, and Loh (2011).

It has been said that money supply has strong effect on the economy progress from a macro economical point of view. In this way, increasing the supply leads to the interest rate decreasing, more investments, economic growth thanks to the consumption increase. The circuit of these changes continues by the companies that increase production as a response to a higher demand. Good business means more need for work force and capital products. In a dynamic economy, the price of a stock exchange will increase and companies will emit shares. If the money supply continues to increase, prices will get bigger, mostly because of the higher incomes. Of course, the population expects an inflation increase because of the big demand and creditors begin to ask for a bigger interest rate for prudent reasons.

From 1990 to 2007, the monetary policies of the biggest economies in the world were highlighted by the adjustment of the interest rate to control inflation. The main weapon used in this case of China was not only the interest rate, but the money supply and fund rates. For that purpose, as a reaction against the economic crisis, China announced at the end of 2008, a full pack of economic inputs worth of four trillion RMB. The government encouraged banks to adopt credits worth of 9.5 trillion RMB in 2009 and other 7.95 trillion in 2010. That strong capital infusion took part of a money supply increase at the beginning of 2009; everything proved to be effective for China's economic growth in the crisis period.

Although, those actions led to other effects that represent an important obstacle in the future development of the country. An exceeding liquidity increased the inflation rate and houses' price increased from 24% to 42% in 2010. Moreover, the consumer price index reached the maximum value in November 2010: 5.1% (EIU ViewsWire, 2010). China's monetary policy became more prudent in that case. In February 2011, bank's fund rate reached 19.5% and deposit interest rate for short term increased fourfold as 6.06% (EIU ViewsWire, 2010). China represents the best example to prove that too much liquidity in the market in order to sustain the economic growth is a dangerous technique. It leads to a greater pressure on inflation.

Table 1

Actual Increasing Rate and Expected Increasing Rate for Money Supply Between 1998 and 2010

Year	M1(%)			M2(%)			Inflation
	Target	Actual	Deviation	Target	Actual	Deviation	
1998	17	11.9	-5.1	17	15.3	-1.7	-1.4
1999	14	17.7	3.7	16	14.7	-1.3	0.4
2000	16	16	0	16	12.3	-3.7	0.4
2001	15	12.7	-2.3	16	14.4	-1.1	0.73
2002	13	16.8	3.8	13	16.8	3.8	-0.77
2003	16	18.7	2.7	16	19.6	3.6	1.17
2004	17	13.6	-3.4	17	14.6	-2.4	3.9
2005	15	11.8	-3.2	15	17.6	2.6	1.82
2006	14	17.5	3.5	14	16.9	2.9	1.47
2007	16	21	5	16	16.7	0.7	4.77
2008	16	9.1	-6.9	16	17.8	1.8	5.9
2009	17	32.4	15.4	17	27.7	10.7	-0.68
2010	17	24.6	7.6	17	18.5	1.5	3.33

Note. The deviation is counted as a difference between actual rate and expected rate. Source: The Central Bank of China, Geiger, 2008.

It is said that this control strategy of the monetary policy is not very efficient because there are lots of strong states that turned to an interest rate as the main control instrument. Notwithstanding, it is said that the interest rate's impact in China is less efficient because of several factors. First of all, the system based on interest rates was slow in coming total liberalization. Interest rates for deposits and lending was still dictated by the Central Bank. Moreover, China's bank industry is no longer monopolistic, but controlled by four banks owned by the state, which actually carry out an influence similar to an oligopoly. And if the system is controlled only by few "players", big enterprises controlled by the state have a very important role in this system. It is estimated that this bank absorb approximate 60% of entire deposits, this leads to a bigger profit rate and they become less sensible to interest rate variations (Akram, Ramzan, Naveed, & Hameed, 2011). Second, another factor can be represented by consumption habits. This is a consequence of the fact that consumption is not that sensible to moves made by the Central Bank on interest rates. When transformations began in 1979, domestic savings rate was approximate 32% (Akram et al., 2011). Economic changes, including the decentralization in economic production, led to bigger savings, both families and companies. As a result, in 2010, the gross intern savings rate as a percent of GDP reached 53.9%, the highest value in the world (as a comparison, in USA the rate is only 9.3%) (Akram et al., 2011). Such a big saving rate admitted China to develop internal investments. Actually, China is a big creditor, USA's main creditor.

What will be the long-term effects of this relation of dependency remains to be seen. China holds at the time being the world's greatest foreign reserve. The source of growth for this reserve was maintaining the local currency at a low artificial exchange rate of the dollar (see Figure 2). The National Bank of China is thus bound to buy the best part of the currency that enters the country, injecting local currency in the financial system. The strong and dependent relationship between these two countries is obvious and developed the premature attitude of high power from China. At the end of June 2012, China's foreign reserves were exceeding 3,200 billions of dollars, Japan 1,200$, whole in which USA does not reach 150,000$ (according to the IMF).

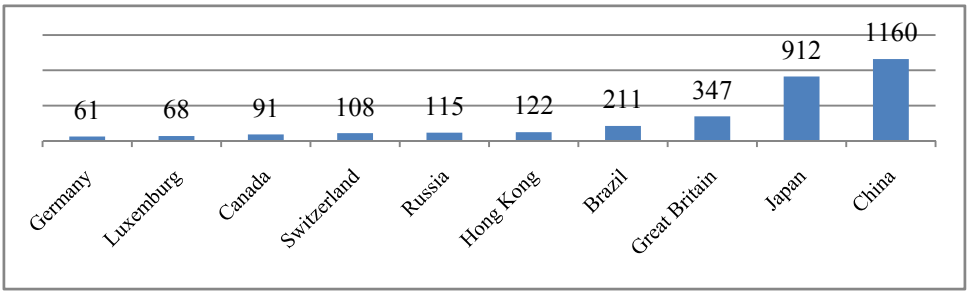

Figure 2. Major foreign creditors of the USA in 2011 (billions of dollars). Source: Retrieved from http://www.statista.com/statistica/197567/main-foreign-creditors-of-the-united-states/.

Methodology

To be able to obtain the expected results, this analysis was conducted through Matlab, by using the econometric theory of multiple regression, based on historical data provided by the World Bank.

Multiple regression (Berry & Feldman, 1985) (term used by Pearson, 1908) has the purpose of highlighting the relationship between a dependent variable (explained, endogenous, resultative) and a lot of independent variables (explanatory, factorial, exogenous). This regression is generalized through the theory of the "general linear model", in which more dependent variables are allowed simultaneously and, also, factorial variables which are not linearly independent.

In most of the situations, it is impossible to determine directly the equation's parameters. Instead, it can be estimated the values by using data from a predefined number of samples (n) (USCC, 2011). To distinguish them from the ones from the regression equation, the equation model will look like this:

$$y = x^* \alpha + \varepsilon$$

where:

y is the dependent variable (explained, dependent);

x is the vector of the dependent variable (explanatory, exogenous), of 1^*p dimension;

α is the coefficients' vector, of p^*1dimension, model's parameters;

ε is a variable, interpreted as an error (measurement error).

In other words:

$$y = \alpha 1 \times 1 + \alpha 2 \times 2 + \ldots + \alpha p \times p + \varepsilon$$

which expresses the linear relationship between y and x.

The Influence of Money Supply and Interest Over the Inflation Rate

In this case, of the study we are leading, we have the following equation:

$$\text{INFL} = \alpha 1^*\text{MMon} + \alpha 2^*\text{RDob} + \varepsilon$$

where:

IMFL is the inflation;

MMon is the money supply;

RDob is the interest rate;

ε is the error (constant).

Table 2 shows the historical data used for analyzing data for China, and Table 3 shows the historical data used for analyzing data for USA.

Table 2

Percentage Values of China

Period	Inflation	Interest rate	Money supply
1987	7.219985792	2.626501894	59.31866054
1988	18.73642675	-2.749941753	58.36513149
1989	18.333044	2.60734753	61.77857029
1990	3.058310672	3.32725277	69.83950974
1991	3.5435753	1.675835588	76.39694236
1992	6.340344882	0.371896177	79.71883299
1993	14.583266	-3.59723002	84.91576078
1994	24.23708802	-7.982424813	85.68952174
1995	16.89706397	-1.473806472	88.54848446
1996	8.324015061	3.424265076	96.12625498
1997	2.806843185	7.020880879	106.3421106
1998	-0.844626159	7.311302963	116.9568968
1999	-1.40789153	7.195067065	126.3435273
2000	0.255304778	3.711241073	129.5184424
2001	0.722902508	3.720735302	133.3143514
2002	-0.765949287	4.698354986	138.52307
2003	1.155909711	2.629776018	142.8250948
2004	3.884182625	-1.24663791	141.8075005
2005	1.821647757	1.58785071	142.0584717
2006	1.463189043	2.249301234	145.3014211
2007	4.750296622	-0.122647706	140.8985643
2008	5.864383723	-2.307885782	139.8856239
2009	-0.702949137	5.938578343	159.1936298
2010	3.314545929	-0.819343828	166.3802883
2011	5.410829643	-1.013037011	167.2565859

Table 3

Percentage Values of USA

Period	Inflation	Interest rate	Money supply
1987	3.740875912	5.123293224	76.74066271
1988	4.009088244	5.636356112	75.12335289
1989	4.82700303	6.851026992	74.12116477
1990	5.39795644	5.989433133	72.89030222
1991	4.234963965	4.898505673	72.15042912
1992	3.028819678	4.059823921	68.79153758
1993	2.951656966	3.725927766	65.58086861
1994	2.607441592	5.000495157	62.04109648
1995	2.805419689	6.354873845	61.27766271
1996	2.9312042	6.387009145	62.2987576
1997	2.337689937	6.390700396	63.12734209
1998	1.552279099	6.85304405	64.89552683
1999	2.188027197	6.433537736	66.81451457
2000	3.376857271	6.919878537	68.29015133
2001	2.826171119	4.551387561	71.18906379
2002	1.586031627	3.002361514	72.83516326
2003	2.270094973	1.974437382	72.63985936

(Table 3 continued)

Period	Inflation	Interest rate	Money supply
2004	2.677236693	1.48676468	71.76462553
2005	3.392746845	2.77770444	72.08434983
2006	3.225944101	4.583650757	73.87744714
2007	2.852672482	5.005765773	77.81002396
2008	3.839100297	2.813927266	83.94101447
2009	-0.355546266	2.163536779	89.16166675
2010	1.640043442	2.073776973	84.3938565
2011	3.156841569	0.504925618	82.99964251

According to these data, regarding the three variables during the period of 1987-2011, by applying the calculation model in Matlab, results the following equation:

$$INFL = -0.1032*Mmon - 1.2357*Rdob + 19.67$$

This model has a maximum error of 8. The result can be attributed to two things. The first one would be the fact that historical data are relatively few, and the second one would be the recently appeared economic crisis, a crisis which made the macroeconomics evolution not to follow a normal course, been strongly influenced by a series of subjective factors.

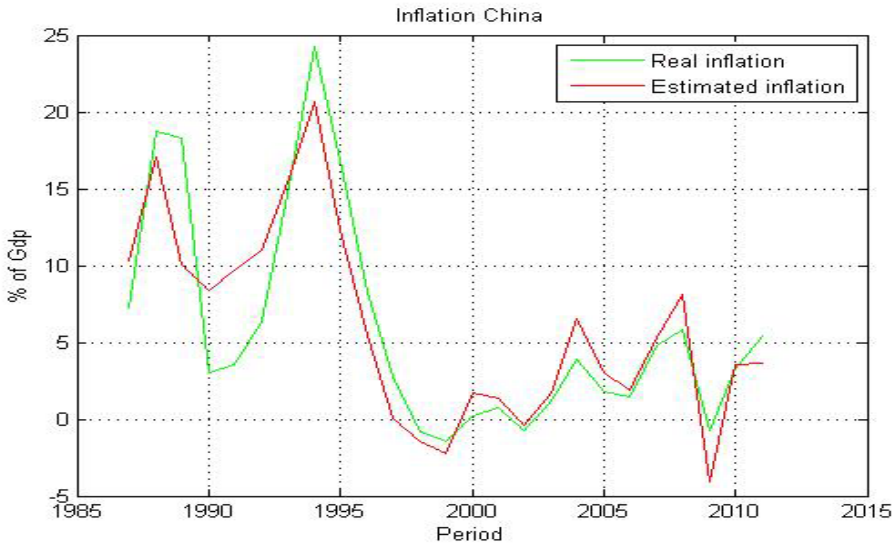

Figure 3. Comparative evolution China, real inflation, and estimated inflation.

From Figure 3, it can be noticed that the estimated inflation based on historical values follows the trend recorded by the real inflation in this period, which indicates the fact that there is a strong connection between the three variables.

The next step is to resume the analysis for the same data recorded in the USA.

By applying the same methodology for the average data recorded in the USA, we obtained the followings:

$$INFL = 0.0197*Mmon + 0.2441*Rdob + 0.4218$$

With a maximum error of 3, error which, even though is a bit high, it can be added up on the count of the relatively few historical data.

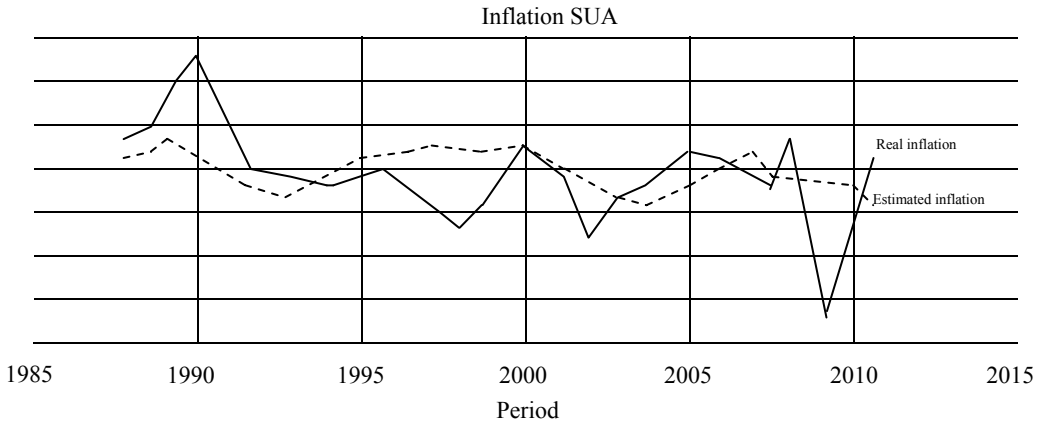

Figure 4. Comparative evolution USA, real inflation, and estimated inflation.

In this case (see Figure 4), it can be noticed some differences between the real values and the estimated values of the model, but the recorded trend is approximately the same. The recorded differences in the model are also a consequence of the fact that the USA has a very open economy, a fact which leads to a stronger exposure towards international markets. Thereby, the Federal Reserve exerts little control over the economy. The same thing cannot be said about China, which, with a centralized monetary policy, can deal a lot easier with shocks coming from international markets.

Conclusions

China and the USA are two different economies which dependent on each other. The USA depend on China mostly due to their money, China is the main creditor of the USA in 2011. But the price paid it is not cheap. China has a fixed exchange rate against the dollar. This enables the use of monetary policy's instruments contributes to the impressive economic growth by boosting exports. According to China's Custom Statistics, the USA has been the main destinations for Chinese exported products, while the USA barely made it to the 4th place.

The impact of the yuan's detraction over the Chinese economy has turned out to be beneficial leading to export growth and foreign reserves growth. Fixed exchange rate and maintaining the national currency detracted has lead to increase in unemployment in other countries, because of many companies moving production in China due to lower costs with the workforce, especially in the USA. The manufacturing sector in the USA lost 2.4 millions of jobs between 2001 and 2008. The fixed exchange rate in China against the dollar was the most important leverage for maintaining price stability in China.

Statistics show that these two economies rule the economic world, being on the first top places as world's most powerful economies. In this growth rate it might be possible that the USA to be exceeded by China very soon. Taking into consideration the grim situation in the EU and the problems faced by the USA after the economic crisis has begun, the monetary policy led by China will set an example, and the free economies could become history. The Chinese centralized model could set a dangerous example. While the economic crisis led to discussions regarding the collapse of the euro zone, to lower standard of living in most of the countries, to austerity measures had to be imagined by many citizens and to deepening budget deficits and to burdensome debt, China continued its climb through stimulation of credit in the inner economy, through growth of money supply for blurring the increase caused by export slowdown. China has control over the main financial and

banking institutions of the country, which allowed the use of monetary instruments at their highest. The USA and other states, that were dependent of the market's fluctuations and of the evolution of international exchanges, suffered a great deal. The lack of liquidity led to resounding bankruptcies and to a capital export towards more attracting countries in terms of interest rates and safety. And China, during the crisis, gave an unexpected feeling of safety to investors.

China directly controls the money supply through the uncontrolled printing of money. China has proved countless times that reaching economic growth is the main goal, and the means do not matter as long as the growth is present. Normally, according to the economic theory the growth of money supply will self-acting lead to inflation. This study proves that this theory is only available in the USA. Thus, for a growth of 1% in the money supply there will be a growth in inflation of 8%. For a growth of 1% in the interest rate, the inflation will grow by 0.6%.

By applying this model in China's case, at variations in the money supply the outcome was inconclusive results about changes in the inflation rate. For keeping its image of an economy which lead to perfection, China will constantly change the data regarding its real economic situation for maintaining its altitude of the high power economy. Thereby, inflation in China will never reflect reality.

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